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HABITS AND HABITATS OF THE NORTH AMERICAN RESURRECTION FERN

By E. F. Andrews

This interesting little plant, known to science as *Polypodium polypodioides,* is closely related to the common polypody (*P. vulgare*) of the North, and one of its local names, "Little Polly," is evidently a popular recognition of the relationship. Other common local names are "fern moss," "moss fern," "tree fern"—from its epiphytic habit of growing on the trunks of trees—and more generally, "resurrection fern," from the manner in which it shrivels up during dry weather as if dead, and comes to life again after every shower of rain.

It is said to be sometimes found as far north as southern New York, and Pennsylvania, whence it ranges west to Illinois and Missouri and south to Florida and Texas, and on throughout tropical America. In the warm, moist climate of our southern coastal plain it finds a congenial home, and is so conspicuous on the live oaks there as to create the impression among tourists and other casual visitors that it does not grow on any others; but this is because they don't look for it anywhere else. Mrs. A. P. Taylor, of Thomasville, Ga., a very competent observer, writes: "It may be of interest, especially to those who believe in its preference for the live oak, to know of the various trees on which I have found it: . . . Here (around Thomasville) it grows on oaks, beech, maple, magnolia (*grandiflora* and *glauca*), *Oxydendron, Osmanthus,* tulip tree, *Symplocos, Cliftonia,* China tree (*Melia Azedarach*) and red cedar. I have never seen it on *Taxodium* or *Pinus.*"

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In the part of its range with which I am best acquainted, the middle and northern portions of Georgia and Alabama, its favorite hosts are the post oak, the elm, and tulip tree, though it is found in greater or less abundance on many others. I have even seen it on the stem of a large poison oak vine (*Rhus radicans*) that had climbed the trunk of an old tulip tree on which the fern had established itself. But so constant is its preference for the elm and post oak that its presence is a convenient test for dis-

FIG. 1. Post oak on a street in Washington, Ga.; the trunk and lower branches covered with a growth of Resurrection Fern.

tinguishing them at a glance, in winter, from other trees of similar habit and exterior when in the leafless state. As a general thing it avoids trees with a smooth or exfoliating bark. The reason for this is obvious, since it could not well secure a foothold on such uncertain supports. There are, however, many exceptions. The magnolia and bay have both very smooth bark, and the cedar exfoliates in long fibrous strips, yet it is not uncommon on all of these. I have never seen it on any kind of a

pine, nor on the hackberry (*Celtis occidentalis*). The bark of this tree is normally smooth like that of the beech, and though it usually becomes very rough and scabby on the trunks and lower branches of old trees, it is so hard and unretentive of moisture that it does not attract the colonies of lichens and mosses which establish themselves so freely on other species, and this fact probably has a more direct influence upon the polypodium's choice of a habitation than the character of the tree upon which it lodges. The fern is not a parasite and its roots never penetrate the living tissue of the host, but there seems to be a symbiotic relation between it and a certain soft, plush-like moss with which it is usually associated, the fern giving shade to the moss, while the latter serves as a reservoir to retain the moisture without which the rootstocks of its partner could not keep alive through periods of protracted drought.

Another peculiarity in regard to habitat is that our "little polypody" does not seek the seclusion of deep sequestered woods like most of the other ferns, but is most frequently found on the trunks and boughs of shade trees around dwellings and on the borders of roads and open woods. It is a familiar object on shade trees in all our southern towns, and instead of avoiding the presence of man seems to flourish best in his neighborhood. This is readily explained as an adaptation to its aerial habit—or possibly the habit may be an adaptation to the situation. If it had always confined itself to low-lying positions on logs and stumps, or on tree trunks in the deep shade of crowded forests where its spores could be carried only a short distance from the parent plant, it is easy to see that it could hardly have become, as it now is, one of the most widely distributed of American ferns.

Its range frequently overlaps that of the common polypody, especially among the Southern Appalachians and their foothills, where it occurs in patches on the face of rocky cliffs and the shelving sides of moss-covered bowlders, as well as on the roots and trunks of trees. The common polypody is of frequent occurrence on top of Lookout Mountain, and I have found occasional specimens of the "little Polly" in Walker Co., Ga., growing

in patches with moss, on the declivity below the great sandstone parapet. But wherever found it can always be readily distinguished from *P. vulgare* by the much smaller, coriaceous, oblong to triangular-lanceolate fronds, covered on the under surface with a thick grayish brown scurf. This scurfy coating plays an important part in connection with the drought resisting qualities of the plant. Viewed under a good hand lens it is seen to consist of a multitude of minute gray scales, each with a dark brown spot in the center. These scales cover the stomata or transpiration pores on the back of the frond, and when there is a dearth of moisture they retard evaporation from the surface, thus causing the frond to curl over on its face, exposing to the sun and air a scale armor that checks evaporation and thus enables the plant to preserve its vitality without water for an astonishing length of time. The agency of the scales in this important function was tested in a number of experiments by removing them* from one or more healthy fronds, leaving others on the same rootstock in their normal condition, and noting the relative time of wilting or recovery in each case. When fresh fronds were deprived of moisture, the denuded frond, other things being equal, always wilted more quickly than the others; but when conditions were reversed and dry specimens placed in water on a bright, clear day, the naked frond, on account of more rapid transpiration, recovered more slowly. In one experiment, where only one half of a vigorous, healthy frond was denuded, the two sides showed very little difference in warm, rainy weather, but when the atmosphere was dry the naked side was first to show signs of wilting, though the difference was not so marked as in the case of separate fronds.

To decide how long the polypodium can tolerate continuous drought without losing its vitality, a number of experiments were carried on at different times and places. In these, each of the specimens used was gathered with its mossy substratum intact, and kept in a dry place, where portions were separated from it at intervals and placed in water as long as any of them continued

* This can be done without injury to the epidermis, by gently scraping off the scales with a sharp knife while in the expanded state.

to show signs of life. There was considerable variation in the results obtained, but not more than might be expected on account of differences of climate in the various localities, the nature of the season, the health and vigor of the individual plants dealt with, etc. It would take too much time and space to go into the details of these experiments, but the results of one of them, which was continued for more than a year, are so interesting that a brief outline of it is given here.

On December 30, 1913, a large mat of polypodium (about 25 x 48 cm.) was gathered from a rocky hillside near Rome, Ga., where it was growing in a thick substratum of moss on one of the numerous outcroppings of shale and slate that form the ribs of the hill. The strata are tilted in such a way that the edge of the laminae is for the most part turned upward, and the mould which collects in the crevices offers a convenient foothold where the polypodium and the prostrate cactus (*Opuntia humifusa* Raf.) are found in close proximity to each other. The fern, with its substratum of moss, peeled off from the rock entire, like the skin of a banana, and was transferred to a flat stone in the basement of my house. The weather being warm and rainy, the fronds were all fully expanded and in fine condition, and it was not until January 13, 1914, that they began to show signs of withering. By January 31, the substratum had become dry and the fronds were all withered. On April 11, May 17, and June 15, specimens detached from the mat with their substratum, and exposed in the rain, revised in each case, within from 12 to 24 hours.

On July 30, the remainder of the mat was removed from the basement to the drier atmosphere upstairs and left on top of a bookcase in my study. October 30 (95 days after removal from the basement) another specimen was put out in a warm mist at 8 P.M., without watering the substratum, and by the same hour next morning it had revived sufficiently to show that it was still alive. The same specimen was then placed in water, and after 12 hours more, the fronds were all expanded but looked weak and sickly. (Note: The best specimens had all been used up,

and the fronds, in this case, were rather small and poor to start with.)

After this the specimens showed a gradual decline both in the quickness of their response when supplied with moisture, and in the relative number of fronds that completely regained their normal condition. On March 8, 1915, after 7 months and 6 days in my study and 7 months in the basement—a total of more than 14 months without water, the last remaining fragment of the mat was placed out of doors on a rainy day, but only 2 fronds expanded fully and regained their normal color. The specimen was then left on a rock under the drip of a gutter on the north side of my house, but it never revived further, and finally died.

THE VEGETATION OF A CINDER FIELD

By George T. Hastings

In the summer of 1916 the Palisade Interstate Park Commission completed the reclaiming of some three acres on the west shore of the Hudson River opposite Hastings. A wall of boulders taken from a rock slide immediately to the north was built across the front of a shallow bay and the space between this and the shore filled in. The filling was first of ashes and rubbish from one to six feet in depth, over this a layer of cinders six inches to a foot in thickness was placed and the whole leveled off. The ashes and cinders were brought up from New York in scows and distributed by small cars run on a track that was shifted as the filling progressed. The final level is about three feet above high tide level. This cinder field made as nearly a sterile soil and one that could retain as little moisture as could well be imagined. The water level in the soil was near the surface and most of the available water for young plants was due to capillarity. The filling was competed so late in 1916 that there was little opportunity for any plant life to develop, but during the summer of 1917 the area became well covered with plants, chiefly growing individually with bare cinders all around but in places crowded together. The following year the tract was covered